

**NATIONAL UNIVERSITY OF LESOTHO
FACULTY OF AGRICULTURE
DEPARTMENT OF SOIL SCIENCE & RESOURCE CONSERVATION**

SSR220 (4)/SSR223 (5) – FUNDAMENTALS OF SOIL SCIENCE

FINAL EXAMINATION

Programmes:

B.Sc. Agriculture – General, Soil Science, Crop Science, Agricultural Extension and Agricultural Economics options;

B.Ed and B.Sc.Geography, and B.Sc. Environmental Sciences

Year 2

May 2019

Total marks = 100

Time: 3 Hours

INSTRUCTIONS: Answer a Total of Four (4) Questions

Questions in Sections A and C are all compulsory

Answer ONLY two Questions from section B

Section A – Compulsory Question

Question 1 (25)

- (a) Choose the material that is best described by the following statement:

_____ is determined by the origin of residual materials from which the soil is formed, the mode or agents of deposition of, as well as the processes through which the same residual materials go.

- The type of parent material
- The nature of the soil. [4 marks]

- (b) Identify the parent materials resulting from the following processes:

- (i) Physical weathering of parent rock, followed by continuous chemical and physical weathering of materials that had weather from the underlying rock, transforming them into soil minerals of different types. [3 marks]
- (ii) Physical and chemical weathering of rock fragments that have fallen from a cliff, into soil minerals. [3 marks]
- (iii) Physical weathering of parent rock; followed by erosion of weathered rock particles and deposition at the foot of the slope by stream water. [3 marks]
- (iv) Physical weathering of parent rock; followed by erosion of weathered rock particles by stream water and deposition into the sea or ocean; then movement and deposition of those deposits by the sea/ocean to the mouth of the sea/ocean where they would accumulate to an elevated level above sea/ocean into coastal plains; and then the continuous chemical and physical weathering of those final deposits into soil minerals. [5 marks]
- (c) Name the soil parent material consisting of very fine particles (1–10 μ m), that is blown by wind and can remain suspended in air until it is deposited with rain. [3 marks]
- (d) Give the two broad groups of soil based on the nature of the parent material? [4 marks]

Section B – Answer any Two (2) Questions in this section

Question 2 (25)

(a) Describe the following terms:

- (i) Pedology
- (ii) Soil taxonomy
- (iii) Soil profile
- (iv) Soil auger
- (v) Soil solum

[2 marks each]

(a) Using the textural triangle attached, determine the textural class names of the two soils in the A and B horizons: [4 marks]

Soil sample ID	Horizons	Clay	Silt	Sand	Textural class name
Soil 1	A	32	25	43	
	B	47	29	25	
Soil 2	A	22	56	22	
	B	36	47	17	

(b) Which between the two soils has higher drainage capacity? Why? [3 marks]

(c) Calculate % total porosity of the soil whose bulk density measured 1.26g/cm³. [5 marks]

(d) Which of the two soils in (a) above matches the % total porosity obtained in (c) above? [3 marks]

Question 3

(a) Give the factors responsible for the following soil colors:

- (i) Black to nearly black color of surface soils
- (ii) Reddish brown color of surface soil
- (iii) Mottled color of subsurface soils.

[2 marks each]

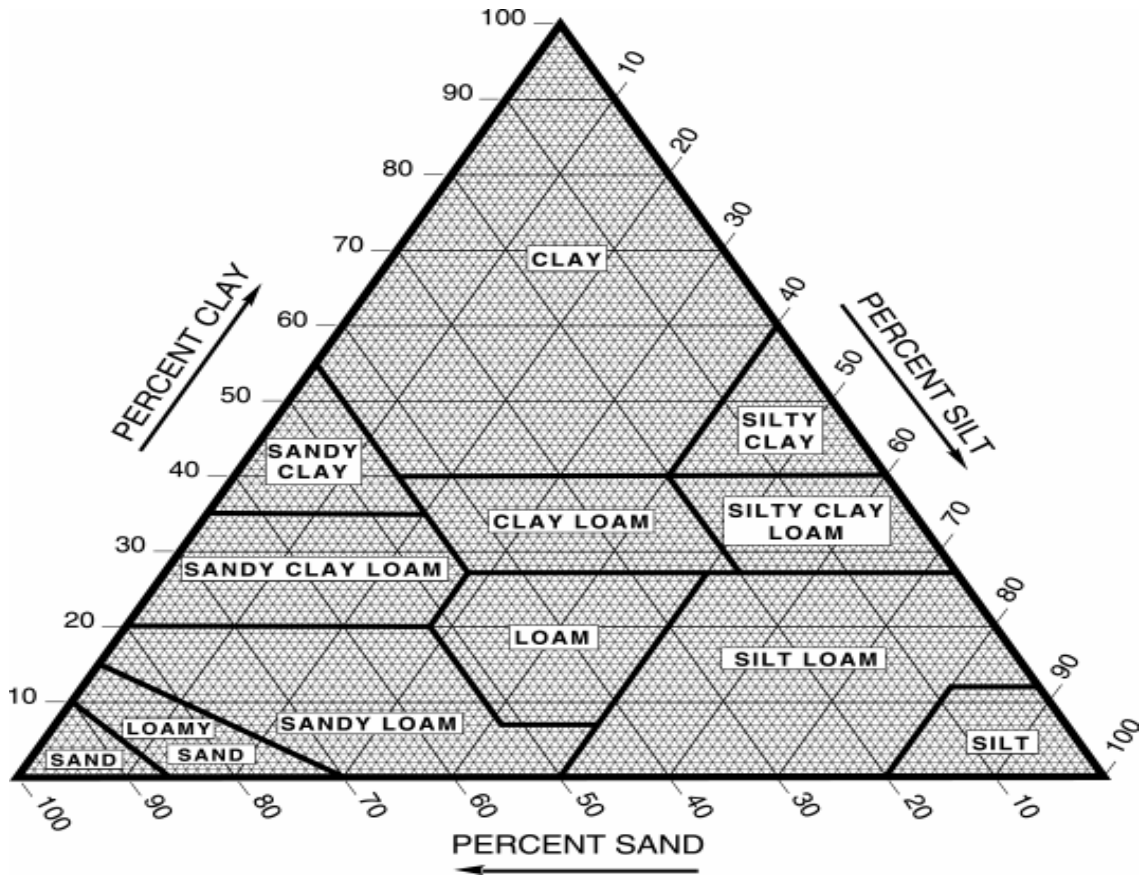
(b) What is the standard tool that is used for determining soil color? [2 marks]

(c) Describe two (2) broad groups of soil organisms based on their functioning. [6 marks]

(d) What are ecosystem engineers? [3 marks]

(e) Which microorganisms effectively decompose organic matter in the following:

- a. Cropping soil (Please explain) [4 marks]
- b. Forest soil? (Please explain) [4 marks]



Soil Textural Triangle

Question 4

- (a) Describe the following:
- (i) Soil water energy [2 marks]
 - (ii) Soil water energy continuum [3 marks]
- (b) Describe soil water energy potential and its components. [8 marks]
- (c) How does soil water pressure differ between the saturated and unsaturated soils? [3 marks]
- (d) Arrange the following in the order of decreasing total energy potential (starting with the highest): [4 marks]
- Field capacity
 - Gravitational water
 - Hygroscopic water
 - Permanent wilting point
- (e) After the measurement of soil water content from the two adjacent fields, Thabiso discovered that field 1 had higher moisture content than field 2, but the plant growing from those two fields were similarly wilting.
- Explain a possible reason for this observation. [5 marks]

Section C – Compulsory Question

Question 5 (25 marks)

- (b) What is cation exchange capacity (CEC)? [5 marks]
- (c) Which soil fractions (components) contribute to cation exchange capacity and why? [4 marks]
- (d) A soil was tested for CEC and exchangeable base cations (Ca^{++} , Mg^{++} , K^+ and Na^+). The results were: 33 for CEC, and 12.0, 7.5, 4.0 and 0.9 for Ca^{++} , Mg^{++} , K^+ and Na^+ respectively, all in $\text{cmol/kg}_{\text{soil}}$. Calculate percent base saturation (%BS) of this soil. [7 marks]
- (e) Give three (3) causes of soil acidity. [6 marks]
- (f) Based on the %BS obtained in (c) above, is the soil acidic or alkaline? [3 marks]